NEWS

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Skylab medical information

DR. FLETCHER'S ADDRESS TO UTAH STATE MEDICAL ASSOCIATION

SALT LAKE CITY -- "America needs space to grow," Dr. James C. Fletcher, NASA Administrator stated in addressing the 76th Annual Scientific Sessions of the Utah State Medical Association here today (Sept. 15).

"I say we need vigorous space activity to keep our society vital, productive and competitive in the years ahead," he added.

Relating the health of the space program to the nation's health, he said, "Some observers are questioning whether the space program, which has accomplished so much in the early years of its existence, is worth pursuing."

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"The goals we set in our space program require the development of new technology. This new technology increases the productivity of our economy. New technology and rising productivity create the new wealth and new capabilities we need to help solve pressing social problems."

Commenting on reports that there is disenchantment with the space program he said, this "... is simply not true." He pointed to the National Aeronautics and Space Administration's $3.298 billion budget authorization, 99.94 percent of the agency's request, as an example of the "very strong support from the Congress."

FULL TEXT OF THE ADDRESS IS ATTACHED

(end of release)

ADDRESS

BY

DR. JAMES C. FLETCHER

ADMINISTRATOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

AT THE

76TH ANNUAL SCIENTIFIC SESSIONS

OF THE UTAH STATE MEDICAL ASSOCIATION

SALT LAKE CITY

SEPTEMBER 15, 1971

MAN'S FUTURE IN SPACE

It is an honor and a pleasure to participate today in the 76th Annual Scientific Sessions of the Utah State Medical Association.

From my point of view, the timing of your invitation was excellent. This is my first formal speaking engagement in Utah since I left for Washington to assume my new responsibilities at NASA in May. I have returned to join in a discussion of scientific matters at a time when NASA has just completed one of the most exciting and rewarding scientific expeditions of all time. And I had the good fortune to be able to bring the three astronauts who made that journey with me to Salt Lake City yesterday.

We can all be justly proud of the Apollo 15 crew -- not only for their skills and courage as astronauts, but also for the enthusiastic and efficient way they prepared for and carried out their scientific assignments.

Our country can also be proud of the pioneering work done by its aerospace medical team to assure the safety of our spacemen in flight. And today medical science is still engaged in the crucial task of determining the extent of man's ability to live and work in this new realm.

So today I want to talk to you about space and health--about three kinds of health.

First, there is the research we still need to do to assure the health of the men who will live and work in space for longer and longer periods of time.

Second, I want to talk a bit about the health -- the budgetary health you might call it -- of the national space program itself. Some observers are questioning whether the space program, which has accomplished so much in the early years of its existence, is worth pursuing.

My third point concerns the social and economic health of American Society. I say we need vigorous space activity to keep our society vital, productive, and competitive in the years ahead.

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Let's begin with the question of astronaut health -- with what we have learned about astronaut health and performance in the Gemini and Apollo programs, and what we expect to learn from the much more ambitious medical experiments planned for the new Skylab program in 1973. Skylab is our next major step forward in manned space flight after Apollo. Skylab has been carefully planned to answer the crucial question of this decade: Does man have a future in space?

In all space flights to date, opportunities for medical research have been rather limited -- from the aerospace medical point of view. Primary emphasis has been on the short-range problems of assuring the astronauts' ability to perform their current missions safely and effectively. Most of the research data has been gathered on the ground before and after flights, because the astronauts have been too busy with other tasks for much medical research while actually in space.

In the Skylab program, however, medical research is going to be an integral part of the mission.

In Skylab we will be looking far beyond the requirements of the immediate mission; we will be seeking answers to questions with a strong impact on the future of manned space flight during the remainder of this century.

We have learned a great deal about man in space from the Gemini and Apollo flights. But some major questions are still unanswered.

In all flights to date we have noted:

-- A moderate loss of weight by the astronauts early in the flight;

-- Moderate cardiovascular deconditioning;

-- Moderate loss of exercise capacity;

-- And a minimal loss of bone density.

On the 14-day flight of Gemini 7, special studies showed a minimal loss of calcium and muscle nitrogen.

And on many flights, but not all, a moderate loss of red blood cell mass has been noted. The cause of this loss is still not definitely known.

To summarize the medical results from Gemini and Apollo, I can make these generalizations:

1. There were no major surprises.

2. As of now, we see no reason why man cannot live and work effectively in space for long periods of time.

3. Man seems to adapt to space flight more easily than he does to Earth's environment after returning from space.

We still need to know, however, whether the adaptive processes man undergoes in space continue or level off after a given time. And if some of the changes do prove to be progressive, we may have to provide corrective or supportive measures to make it easier for man to re-adapt to Earth's gravity after a long space flight.

The fears which some responsible persons had before the first manned flights -- fears of excessive radiation, disorientation, psychological disturbances, and dire physiological effects from weightlessness -- have, of course, proved groundless.

We are now quite confident about man's ability to live and work for relatively long periods in space. But we are not yet completely confident about the condition of our spacemen when they return to Earth (or land on Mars) after a long weightless period in space. We will begin to answer these many questions in the Skylab program.

We have two more Apollo missions to the Moon -- Apollo 16 and 17 -- which we will fly in 1972. Then in 1973, we will turn our attention to Skylab. Actually, Skylab and its vital experiments have been in preparation since 1965. The public usually thinks of a space project as beginning in earnest when the flights begin, but we at NASA have to spend eight or ten years to bring a challenging new program to fulfillment... or about the time it takes to educate and train a good doctor.

I have chosen to stress Skylab in my remarks today -- rather than other new programs we are getting underway at NASA -- because of the prime importance of the medical experiments to be performed. Skylab will be an orbiting medical laboratory where any MD would feel right at home -- as soon as you got use to floating around weightless.

In fact, four of the scientist-astronauts in training for the Skylab program are physicians. Crew selections have not yet been made, and many factors will have to be considered, but we certainly recognize the desirability of having a physician aboard Skylab to help carry out the medical and other experiments.

There are several important points to remember about Skylab.

-- Skylab is big. There will be plenty of room to move around in and work in. The habitable volume of Skylab is almost 13,000 cubic feet. That's equivalent in size to a three-bedroom house.

-- Skylab will be a solar observatory, an Earth observatory, an industrial laboratory, and a space technology workshop, as well as a unique and invaluable medical laboratory.

-- Skylab will provide our medical scientists the long duration flights -- missions of 28 and 56 days -- they need for their experiments. These flights will be four times longer than any we have had to date, and more than twice as long as any Russian flight up until now.

-- The crews of Skylab will have important scientific and engineering work to do. They will seek to demonstrate what men in space can do better than unmanned spacecraft can. Without such a demonstration, the question of man's health on long space flights would be academic.

-- Finally, we must remember that Skylab is our first experimental space station. It is a substantial step forward in spacecraft technology. It is the forerunner of the large manned space stations we expect to have in orbit in the next decade. So far, of course, no decision has been made to build such space stations. They are now under study, and we need the results from Skylab before any final decisions are made.

The Skylab complex will be launched into Earth orbit by the first two stages of the giant Saturn V rocket. The Saturn V which sends Apollo to the Moon has three stages, but only the first two stages are needed to put Skylab in Earth orbit. In fact, the main part of Skylab, the crew's living quarters and workshop, is a Saturn third stage that has been remodeled, so to speak. The large hydrogen tank of the rocket has been made into the crew quarters; and the smaller oxygen tank will be used for trash disposal. The Skylab crews, our first true residents in space, will not be litter bugs.

Skylab will be launched in the spring of 1973 without the crew on board, but will carry supplies for three men to live in space for a total of 140 days. Three separate crews of three men each will live and work in Skylab for periods of 28 days, 56 days, and again 56 days, if crew health permits. This accounts for the 140 days of supplies on board.

The crews will come up from Earth, and return to Earth, in an Apollo spacecraft. The Skylab will be equipped with a special docking station where the crew can park their Apollo while living in Skylab.

Skylab will also have a large structure attached called the Apollo Telescope Mount, or ATM, which will house a complex of large telescopes and other instruments for solar studies.

The Skylab complex will also include a large Airlock Module, which will enable the crewmen to leave Skylab for work outside the station.

Two sets of large solar panels will be unfolded to provide electric power for Skylab housekeeping and for operating the experiments.

The medical experiments planned for Skylab will investigate the following areas of interest:

-- The nutritional needs of spacemen on long flights, which may be quite different from nutritional needs on Earth.

-- Changes in body weight, muscular and bone changes, and body fluid changes, including many different kinds of blood tests.

-- Cardiovascular changes and metabolic activity.

-- The human vestibular function, sleep monitoring, and time and motion studies recorded by camera to determine what kinds of work men can do efficiently aboard spacecraft and how to increase work efficiency.

In one experiment -- the mineral balance experiment -- the astronauts will follow a carefully programmed diet before and during their flight. The amounts of protein, calcium, phosphorus, magnesium, and sodium taken daily will be carefully controlled. Fluid intake will be metered and recorded. The mass of any uneaten food will also be measured so that accurate records can be maintained.

The daily fluid intake and urine volume produced by each astronaut will be measured and a representative daily sample of 125 milliliters of urine will be collected, frozen, and stored on board the Skylab for return to Earth with the astronauts. All feces and all vomitus, if any, will also be collected and stored for return to Earth for post-flight analysis.

In related experiments, other blood and urine samples will be examined to obtain information about endocrine adaptation in space; and a Gamma-ray scanning device will be used before and after flight to detect changes in density of arm and heel bones and thus to measure any decalcification that has taken place.

To carry out the mineral balance experiment and related studies successfully, specimens will have to be weighed accurately in the 50 to 500 gram range, and the body mass of the astronauts will have to be checked daily.

Since ordinary scales do not work in space, a new kind of mass measuring device has been developed which measures the inertial property of a given mass rather than the pull of gravity on it.

Another group of experiments is designed to provide new information -- indeed, our first information -- on the time course of cardiovascular deconditioning.

In one very interesting experiment, a lower body negative pressure device will be used in place of a tilt table to challenge the cardiovascular system. This device consists of a cylinder into which the lower half of the crewman's body is placed, with a rubber diaphragm forming an air seal around the crewman's waist. When a partial vacuum is created in the cylinder, blood flow to the legs is increased, much as when a tilt table is used on Earth. Plethysmographs, or strain gauges, are then used to measure the expansion of the legs, and this in turn will measure the amount of blood pooling in the legs.

Vectorcardiograms will also be taken during the lower body negative pressure tests, and during more conventional physical exercise performed on a bicycle ergometer.

All of the blood tests needed for the many Skylab tests will be obtained before and after flight. No blood samples will be drawn in space, unless needed in some medical emergency. Included in the blood tests will be investigations of the extent and cause of red cell mass loss and the possible loss by the astronauts of various types of immunity to disease during their long stay in space.

A rotating chair, designed for space use, will be installed on Skylab for following the vestibular function as it adjusts to the space environment.

A special sleep analyzing device developed for Skylab is now available commercially for clinical use. Reports on the astronauts' ability to get a good night's sleep in space have been mixed so far. Some report no difficulty sleeping; others have slept poorly, have become exhausted, and then have slept profoundly. Fatigue after the flights has been a characteristic finding.

On Skylab, one astronaut will be tested during 15 eight-hour sleep periods on the first flight and 21 eight-hour sleep periods on the second flight. The astronaut will wear a specially fitted cap containing electrodes which will pick up electroencephalographic and electro-oculographic signals. These EEG and EOG signals will be fed into the sleep analyzing device, and will be recorded on magnetic tape. The tapes will be returned to Earth for further study.

Objective information on man's ability to sleep well in space is important to evaluating man's continued ability to work well over many months in space.

I might mention, too, the bioscience experiments which will investigate the effect of zero gravity on single human cells and circadian rhythm changes in vinegar gnats and pocket mice. These experiments will be installed in the Apollo spacecraft; they will not be transferred to Skylab proper; and they will return to Earth with the astronauts.

There will be other experiments, too, having to do with the habitability of Skylab -- interdisciplinary studies involving medicine, engineering, architecture, and, I suppose, inn keeping.

I have stressed the significance of the Skylab medical experiments, but I should also point out the importance of the other experiments on board, and the progress in using space that Skylab will represent.

Skylab will be remarkably well equipped as the first manned solar observatory in space. Telescopes and other astronomical instruments will probe the solar system at altitudes above the obscuring veil of the Earth's atmosphere. The astronauts on duty in the observatory will be able to scan the sun's disc for targets of unusual scientific interest and then point their instruments with great accuracy -- with 10 times the accuracy of the unmanned solar observatories now in orbit.

The versatile astronauts on Skylab will also carry out experiments to demonstrate the value of manned and unmanned spacecraft in surveying earth resources -- and man's depredations on Earth, too, for that matter. It is becoming clearer to us all the time that the basic natural resources of our planet -- air, water, minerals, wild life, and living space -- will have to be managed with greater care and wisdom and on a global basis to meet the needs of our planet's growing population. The global views we get from space -- and can get only from space -- will greatly facilitate the global approach to management of Earth resources that the future will require.

Some very interesting experiments on materials processing in zero gravity -- the melting and welding of metals, crystal formation, the production of perfect spheres, and things like this -- will also be carried out on Skylab. These industrial-type experiments will give us valuable information on how to build and repair structures in space and how space might be used for manufacturing products which cannot be produced on Earth.

And, of course, there will be a number of important experiments on Skylab having to do with advanced spacecraft technology.

Actually, the very fact that the crew of Skylab will have non-medical experiments to perform is part of the basic medical experiment. In other words, an effective way to test the health and stamina and mental alertness of the astronauts during long space missions is to give them demanding and exacting scientific tasks to carry out. These are tasks we know they can do when in good mental and physical condition on the ground. Their ability and their motivation to perform these demanding tasks week after week in space will be a very important part of the medical data gained.

So we see that the medical experiments are not academic exercises. Their purpose is to assure us that men can live and work in space for extended periods because men <u>are</u> <u>needed</u> in space for many different kinds of useful work.

You have no doubt heard or read the arguments that man is too expensive to maintin in space, that automated spacecraft can do the same work at much less cost. Anyone who watched the Apollo 15 astronauts at Hadley Rille for even a few minutes could see the tremendous advantages of man over machine on the Moon -- or, better said, the tremendous advantages of man <u>and</u> machine, working together on the Moon.

The success of Apollo has not stilled the debate over manned versus unmanned space flight. Some scientists still question the need for man on Earth orbital flights. Some question whether it will be worthwhile to build large space stations for men to work in Earth orbit over long periods of time.

These are legitimate questions. Skylab will help answer them. For example, the results from the Skylab solar observatory which men will operate can be compared in a meaningful way with the results we are getting from our unmanned solar observatories.

But I think the important thing to remember in the debate on the merits of man versus machine in space is that this need not and should not be a simple either-or proposition.

Already we know that many very inportant space missions in Earth orbit can be performed quite adequately and at less cost by unmanned spacecraft. We are also convinced that man's brain power, and dexterity, and adaptability, and creativity will be as important in Earth orbit as in exploring the Moon or Mars -- or as they are on Earth, for that matter.

Turning now to the health of the space program, I am glad to report that this nation has a well-planned program underway to explore and use space in the decade ahead. I am also glad to be able to report that this program received very strong support from Congress during action on the NASA budget for the current fiscal year. The President's budget request for NASA was $3.3 billion and Congress appropriated $3.298 billion, or 99.94 percent of our request. Talk you may have heard about growing "disenchantment" with the space program is simply not true -- certainly not in Congress. What is true is that we are working very hard at NASA to plan and carry out a national space program that meets the needs of the nation in space in this decade, just as we met the somewhat different needs of the last decade.

As the decade of the 60s was drawing to a close, it became obvious that there were many exciting and rewarding things we could plan to do in space in the 70s. But we could not begin to do them all. We had to make difficult decisions, and establish new priorities in space. We had to choose wisely and responsibly, because the choices we made would to a large extent determine America's future in space for the remainder of this century. We had to keep in mind what other countries would probably do in space, other countries which are competing with us for power and prestige and economic and political leadership in a dynamic world.

The program worked out by NASA, and approved so far by the President and the Congress, is sound; and in my opinion it meets our minimum national needs in space as well as they can be met with the resources available to us now.

Our current program stresses both space exploration and the practical uses of space. It is a balanced program to study the planets, the Sun, and the basic mysteries of the universe. It is also a program to learn a great deal more about the most important planet -- our own Earth.

Our current program will force the rapid development of new technology and provide this nation with new capabilities to do more in space at less cost. It will promote the economic well-being of the country and enhance the national security. It will, I hope, continue to be a source of inspiration to our young people. It will, I also hope, continue to be accepted by the American people as a legitimate and worthy way of fulfilling our destiny as a pioneering nation.

Here, very briefly, are the major elements in our space program for the 70s:

--Skylab I have already discussed. Flights will begin and end in 1973. The next logical step, large space stations in Earth orbit, is being studied.

--Most of our effort in this decade will be devoted to developing the Space Shuttle, which we have identified in our priority studies as the key to further American progress in space. The Space Shuttle is a new aerospace vehicle for putting payloads and passengers into Earth orbit with greater efficiency and less cost than the expendable one-shot rockets we now use. The Space Shuttle will be re-usable, like a modern airliner. It is an exciting project, I regret I do not have the time to discuss it in detail today.

--Development of the nuclear-poered NERVA rocket, which could be used to take heavy payloads to very high Earth orbit or the Moon, or to take Men to Mars, has been deferred; but work is continuing on selected long leadtime components so that we can move more quickly to build this highly efficient rocket when the need arises.

--In this decade we will steadily increase our efforts to explore the planets -- all the planets of the solar system -- using unmanned spacecraft.

--A Mariner spacecraft is now enroute to Mars. It will orbit Mars and send back pictures of the surface. In 1973, a Mariner spacecraft will be sent to Venus and Mercury. And in 1975 we will launch two large new Viking spacecraft to land instruments on Mars in the search for extra-terrestrial life.

--We are also developing a remarkable new space craft to explore the outer planets, Jupiter, Saturn,Uranus, Neptune, and Pluto. This space-craft is called TOPS, for Thermoelectric Outer Planet Spacecraft. This new spacecraft must have an unprecedented degree of reliability and will require substantial advances in space communications and on-board power systems, be-cause some of its missions may last for 10 years and reach out more than three billion miles from Earth.

--We are also developing a new scientific spacecraft called the High Energy Astronomical Observatory for use in Earth orbit. This spacecraft will investigate the recently discovered sources of great energy coming from deep in the universe. So far these sources of energy are very puzzling because they cannot be explained by any physical process already known to us, such as the atomic fusion that takes place within the Sun. Our development of a new spacecraft to study these mysterious energy sources may prove every bit as important to the future of mankind as, say, the voyage of Columbus to find a shorter route to the Indies.

--We will also continue to develop new technology to obtain practical benefits from space. We will improve weather and communications satellites and develop the Earth Resources Technology Satellite, called ERTS, will be unmanned and complement the experiments on Earth observations to be carried out by the astronauts of Skylab.

--NASA will also continue to be active in aeronautical research. One major project in this field is the development of an experimental short take-off and landing plane for short haul transportation in urban areas. Emphasis will be placed on the reduction of noise generated by such a plane.

Now, how does all this relate to the third point I wanted to make, which is NASA's contribution to the general health and well being or our society?

I'll sum it up this way: America needs space to grow. The goals we set in our space program require the development of new technology. This new technology increases the productivity of our economy. New technology and rising productivity create the new wealth and new capabilities we need to help solve pressing social problems.

Reaching for the Moon has kept America on its toes as President Nixon has said, "A great nation must always be an exploring nation if it wishes to remain great."

Leadership in space has also given the United States a very useful tool for encouraging international cooperation in space and other fields.

It is important to keep in mind the cycle of space progress. First we set challenging national goals. Then we develop the new technology required to meet these goals. With the new technology in hand, we complete our planned programs and produce both expected and unexpected benefits. Appraising the benefits, and with new ideas for using space more effectively, we are encouraged to set new goals, and the cycle continues.

New technology developed in the space program is being put to use in many ways through a continuing feedback process. Every year about 1,000 technical innovations generated by the space program find Earthly applications. They lead to better ships and planes, kitchen appliances and farm equipment, better weather forecasting and storm warning systems, better communications, better medical instruments and hospital equipment, better utensils and tools for every day life.

The space program is truly an engine for progress. It is good medicine for America today.

As I mentioned earlier, NASA's budget for the current year, as approved by the President and Congress, is nearly $3.3 billion. Even in this day and age $3.3 billion is a lot of money. So it is to be expected that persons concerned primarily with health needs, or anti-poverty programs, or acute urban problems may look at the NASA budget for space and aeronautics and say, "We could put that $3.3 billion to better use."

But could they really? I don't think so.

First, let us put NASA's budget figure in perspective along with the rest of the federal budget. $3.3 billion is actually less than 1-1/2 cents of the federal budget dollar. We are already spending 42 cents of the federal budget dollar on human resources, including Health, education, income security, and veterans benefits. And we are also spending 34 cents of the federal budget dollar on national defense. So even if the space program were abolished entirely -- which would be a calamity for this country -- the amount available for other programs, 1-1/2 cents, would be relatively insignificant.

Looking at it another way, $3.3 billion is less than one-third of one percent of our Gross National Product, and it is only $16 for each person in this country.

Sixteen Dollars. I think it is probably worth $16 a year to each of us, and especially to our children, just to know that great voyages of discovery are taking place in our time, and indeed before our very eyes.

When you stop to think about it, it does not make sense from any anle to talk about turning our backs on space to save $16 per person per year.

We know, for example, that the Russians are planning large space stations in Earth orbit. Would the American people really be content to turn this vital field of endeavor over to another country to monopolize? I am sure they would not. The American reaction in 1957 and 1961 was plain enough. But we will be giving the Soviet Union a monopoly in space if we end our manned space program after Skylab, if we do not proceed vigorously with the Space Shuttle and with our Space Station studies.

I believe very strongly, as President Nixon does, in the potential benefits that could come from greater space cooperation with the Soviet Union and other countries. But we will reap these benefits only if we remain active in space.

Our country will be healthier and stronger and better able to face up to and solve its many problems at home and abroad if we continue with challenging, stimulating, and rewarding national space effort.

I thank you.

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